

and all for the sake of filthy lucre. At the small university where I am, where the dullest pedantry sits enthroned, and where natural science is learnt from the Greek authors or from Wilbrand's writings, I should otherwise die of hunger."

However much Liebig may share Berzelius's opinion of French chemical work in general during the thirties, he will hear of no word of disparagement of his old master Gay Lussac, for whom he had the most genuine respect and esteem. A captious remark by Berzelius respecting Gay Lussac at once rouses Liebig, and his impetuous pen dashes off a panegyric which is almost eloquent in the warmth and intensity of its feeling. The only thing to his discredit that Liebig will allow is that, in common with his countrymen, Gay Lussac is not sufficiently attentive to what is done outside France:

"A certain mental indolence prevents the French, to their shame be it said, from making themselves acquainted with foreign work. Gay Lussac shares this failing, and feels that it will gradually effect the ruin and extinction of all scientific growth in France: all his letters to me are filled with complaints on this score, and principally as regards himself. However that is no fault in his character, and can well be forgiven him when one takes his other good qualities into account."

A letter from Liebig, dated December 28, 1831, announces the discovery, and describes the properties of chloral, a "Substanz welche ich, da ich keinen besseren Namen weiss, Chloralkohol nennen will." Berzelius, in his reply, gives an account of his work on tellurium. In May, 1832, Liebig writes that he has begun to work on amygdalin.

"I am on the point of becoming Wöhler's enemy: I see that Fate will not allow either of us to do anything that the other has not already done or is on the point of doing: all originality goes to the devil. He suggests that we should do a joint investigation on bitter almond oil—and just before I got his letter I had written to all the apothecaries I knew of to procure me bitter almond oil, because I too had the matter in view."

What came out of that memorable investigation on oil of bitter almonds no chemist needs to be reminded of. On July 2, Liebig writes that he has been engaged in determining the composition of an "ether-like substance," sent to him by Döbereiner, who had named it "Sauerstoffether."

"Oxygen-ether is no name for this substance. I am, however, very stupid at naming things. What think you of acetal (acetum and alcohol)?"

In more than one of his letters Liebig held out the hope to himself that he might be enabled to visit Berzelius in Stockholm, and do some research in common with him, and he sends to Wöhler for a Swedish grammar. The terrible pressure of his work at Giessen at this time is beginning to tell upon him. He writes to Berzelius:

"I am always ill, and fear my life's thread will not spin out much longer. Each work I undertake makes me worse, and the slightest effort excites me as if I were in a fever. Wöhler and my family tell me daily what a fool I am; however, we shall see. If the journey to Stockholm does not mend me, then I shall never be cured."

Berzelius answers:—

"The pleasure which your news of matters scientific gave me, great though it was, is as nothing compared

with that of your promise to spend some months with me and to do a piece of work with me. I have seldom had such a pleasant surprise, but now comes the question: When is this good fortune to befall me? You do not need to speak a word of Swedish to come here. If you wish to learn it, may it be my privilege to be your teacher. Come soon and spend the winter months with me. A Swedish winter is healthier than a German one. Your depressed nervous system will right itself here. We will work, joke, and skate, and not over-fatigue ourselves, and yet labour to good purpose. You will find my laboratory far below your expectation. It is small and badly furnished. But it is just in such a place that one learns to do with little."

The visit, unfortunately, was never made. Wöhler lost his wife in the summer of that year, and in his dejection sought the society of his friend at Giessen. Moreover, the outbreak of cholera at various ports in North Germany made travelling irksome and dangerous. As it was, the two never met again. The correspondence was maintained, with intermissions, down to 1845—that is, until about three years before the death of Berzelius. Little by little misunderstandings arose which eventually ended in coolness, despite the most persistent efforts by Wöhler to preserve friendly relations. The conservatism of Berzelius, who clung, with the obstinacy of age, to views which the rest of the world regarded as obsolete, reacted painfully on the strong-willed, impulsive nature of Liebig, who could as little brook contradiction. There was more than one sharp passage of arms, and at length open rupture. Berzelius made his *Jahresbericht* the vehicle of many bitter attacks on the work of the Giessen school, to which Liebig, restrained by Wöhler, and to some extent swayed by mixed feelings of reverence and pity, seldom replied.

His sentiments towards the great master will be evident from the following excerpt from a letter to Wöhler, with which this most interesting volume closes:

"The opinions and theories of Berzelius were a clear and formal expression of the ideas of his time, and therefore of great value; but they went no further. I will not say that this was a fault, but it would have been a virtue had he possessed a larger measure of that creative thought which I may term the poetry of natural philosophy."

T. E. T.

BACTERIOLOGY FOR THE STUDENT.

Manual of Bacteriology for Practitioners and Students, with especial reference to Practical Methods. By Dr. S. L. Schenk, Professor Extraordinary in the University of Vienna; translated from the German, with an Appendix by W. R. Dawson, B.A., M.D. (Univ. Dublin). 8vo. 310 pp. (London: Longmans, Green and Co., 1893.)

THE bacteriological library has recently been enriched by yet another text-book which, although only published in German a few months ago, has already appeared in an English translation. In this work we have the responsibility divided between the author and translator, for the latter has not merely acted as interpreter, but has added numerous foot-notes, besides an appendix intended to bring the book as far as possible up to date, all of which additions are signed by the translator. It does not

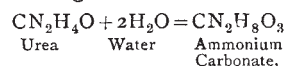
appear to us that there is much advantage in thus dividing the responsibility in a small text-book which does not contain any original or speculative matter of importance ; and in our opinion the reader would have gained had the German original been freely edited by the translator, who should have borne the entire responsibility for the English edition.

The arrangement of the material is much the same as in most previous works on this subject, but the description of a larger number of micro-organisms, considering the size of the book, is attempted. In this matter the time has now come for a new departure, for with the continual additions to the number of known bacterial forms, it is both impossible and undesirable that the descriptions of all of them should find place in the body of a text-book. For the purpose of illustrating the principles of bacteriology, comparatively few forms need be described in detail, whilst for an account of those forms which are of secondary importance, special works should be consulted. A work of this kind, which endeavours to describe in the tabular form, every micro-organism hitherto discovered, fortunately already exists in the shape of Eisenberg's "Bakteriologische Diagnostik" (Hamburg and Leipzig, 1891), so that the necessarily brief and imperfect descriptions of bacteria which are to be found in small text-books, like the one under review, become worse than valueless, inasmuch as they take up space which should be devoted to the discussion of general principles. Now, in this latter particular the work before us is specially weak ; not only is the preliminary chapter on the "general morphology and biology of micro-organisms" very scanty, but the introductory matter at the commencement of the several chapters is generally also quite inadequate. Thus, for instance, in the chapter on the micro-organisms of soil we find no less than two pages devoted to the description of such obscure and unimportant forms as *bacterium mycoides roseum*, *b. radiatus*, *spinosus*, *liquefaciens magnus*, *scissus*, and *clostridium fœtidum*, whilst there is absolutely no mention of the bacteria producing nitrification, nor of the organisms occasioning the tubercles in leguminous plants, which are of such enormous importance, both from a practical and theoretical point of view.

In that portion of the book devoted to the practical methods, we find very ample descriptions of the mechanical details for staining bacteria, but the account given of the principles upon which these methods rest is very meagre, and often betrays much ignorance of chemical principles in general. Thus, what are we to think of the statement that "*aniline oil* and *phenol* are the mordants (*sic*) most used in bacteriological research"? Surely a few words from a competent chemist would be calculated to put some order and arrangement into the wilderness of empirical staining recipes with which the student is confronted, and would prevent such inaccuracy in the use of old-established technical terms. A mistake of more practical importance, which a little chemical knowledge again would have rendered impossible, is the statement on page 20, that plates intended for culture may be sterilised "after being cleansed with alcohol and corrosive sublimate"; in this case, however, we are inclined to believe that the "alcohol" being placed *before* instead of *after* the "corrosive" sublimate must be a

lapsus plumæ which has failed to receive correction in the proof.

Of the same order, again, is the statement that some bacteria "cause a splitting-up of urea into ammonium carbonate"; surely if the reaction in question, and which consists in the adding on of two molecules of water,



can be described as "a splitting up," the addition of two chimneys to a house might as logically be called a disruption of the building !

The author in his preface states that "conformably to the scope of a hand-book like the present, all references to the literature have been omitted," but the names of investigators have been freely introduced in the text, and in some cases they have been selected apparently without a due knowledge of the literature. Thus, from the text (p. 124 and p. 156) it would appear that it is to Rubner and Kirchner that we are indebted for the discovery of the great bacteriological efficiency of the soil as a natural filtering medium, whilst we were certainly under the impression that Pasteur, not to mention others, showed the bacteriological purity of spring and deep well waters before the names of the above gentlemen were known to the scientific world. In the same way the discovery of the increase in the efficacy of chemical disinfectants by moderately raising the temperature is ascribed to Heider, whilst it was really first made by Dr. Wynter Blyth, some eight years ago, but his paper, which was published in the Proceedings of the Royal Society, was doubtless unknown to both Heider and the author of this book ; but the translator might, in the interests of British science, have seen that the papers in that and other English media of publication had received their due. In the chapter on Morphology we find no mention of the researches of Ray Lankester and others on the polymorphism of *beggiatoa*, which are of such interest in connection with those phenomena of variation in both the form and function of bacteria which are now beginning to receive the serious attention of investigators ; nor is there, indeed, any special reference to this subject of variation, which at the present time is certainly one of the most important in the whole domain of bacteriology.

A considerable part of the translator's appendix is devoted to the bactericidal action of light ; here again we think that the work of the original discoverers, Downes and Blunt, has been inadequately appreciated, for these investigators practically explored the whole subject in outline, and the more recent researches have principally consisted in a confirmation of their results, and in filling in details ; thus they showed that the bactericidal action of sunlight is independent of rise in temperature, that the most refrangible rays of the spectrum are the most active, that their effect, moreover, is highly favoured if not entirely dependent on the simultaneous presence of oxygen, and, further, that the bacteria may be destroyed by light in the absence of any culture-medium, but that they are more resistant to light when immersed in water or very dilute culture material. Again, we find no reference to one of the most interesting recent additions to our knowledge of this subject, viz. the discovery by Laurent that exposure to sunlight causes some chromogenic

bacteria to lose their power of producing pigment, either temporarily, as in the case of the *bacillus prodigiosus*, or even permanently, in the case of the *bacillus ruber* of Kiel. We are, therefore, surprised at being categorically informed, both in the introduction and in the appendix of this work, that pigment is formed especially under the influence of light, a statement which is entirely out of harmony with the observations of Laurent, and for which the experimental foundation should have been carefully set forth.

These and other points of a similar character will doubtless be rectified by the translator in preparing a second edition, which it would be well to amplify with references to literature, with which even an elementary student in a new science must at once be made familiar. The illustrations are in the majority of cases very good, and contrast most favourably with those we have seen in some recent works of the kind in which photographic representations have been attempted. The coloured prints of cholera and typhoid bacilli are especially excellent.

OUR BOOK SHELF.

Exploration of Mount Kina Balu, North Borneo. By John Whitehead. (London: Gurney and Jackson, 1893.)

MR. JOHN WHITEHEAD belongs to the much-maligned class of field-naturalists. For the purpose of obtaining a knowledge of the ornithology of Mount Kina Balu, he spent nearly four years collecting in the region, and accumulated a large number of new species. In addition to visiting North Borneo, he stayed some time at Java and Palawan, and made an expedition into the State of Malacca. The rather cumbersome volume before us recounts the story of these explorations. It consists of 192 pages of general description and 115 pages of matter reprinted from the proceedings of various Societies. Thirty-two excellent plates illustrate specimens from the extensive zoological collections made by Mr. Whitehead, and the places and peoples seen by him. It need hardly be said that these add considerably to the value of the book. Several woodcuts are also included. It would be ungracious to find fault with Mr. Whitehead for looseness of expression, since he craves indulgence for his "literary shortcomings." He found it far easier to explore an unknown tract of country than to write an account of his travels. Like some other travellers who have given to the world accounts of their wanderings, Mr. Whitehead dwells too much on trivialities. But for all that, there is much that is new and interesting in the book, and one cannot but admire the indomitable spirit which carried the author through numerous difficulties, and enabled him at last to reach an altitude of 13,525 feet on the mountain of Kina Balu.

Pillow Problems. Curiosa Mathematica, Part II. By Charles L. Dodgson, M.A. (London: Macmillan and Co., 1893.)

IN these pages we have a series of problems worked out, or, as the author says, "nearly all thought out during sleepless nights." In the preface he informs us the exact method of procedure, and the way in which he obtained his results. The problems are about seventy in number, and deal with many branches of mathematics, but chiefly with algebra, plane geometry, and trigonometry. The order of the three and only chapters is as follows: questions, answers, and solutions; and he explains the reason for this peculiarity in the preface. Considering the problems themselves, one is apt to think that some of

them at least are not so very hard, but the publication of them will be found very interesting and perhaps useful to those of ordinary mathematical powers, who may like to follow the same routine way of thinking as that adopted by the author.

The A B C Five-Figure Logarithms. By C. J. Woodward, B.Sc. (London: E. and F. N. Spon, 1893.)

THIS small book of logarithms may be said to be a second edition of the tables previously published by the author. In addition to the tables of mantissæ of numbers, the same A B C system has been applied to logarithms of arc functions, with only a slight difference in the method. Besides these the square roots of numbers (from 1 to 100) to three places of decimals are given, and a table of "numbers often wanted," and of the densities of gases, weights and measures, &c. To facilitate the finding of the logarithms, &c., a lateral index is adopted. Besides being a compact and convenient set of tables, the worker will find them easy to use, and accurate enough for such calculations as are generally met with in the physical laboratory, the class-room, &c.

Enunciations in Arithmetic, Algebra, Euclid and Trigonometry. By P. A. Thomas, B.A. (London: Macmillan and Co., 1893.)

IN these pages one is treated to a selection of some of the chief questions that relate to Arithmetic, Algebra, Euclid, and Trigonometry. Stress is laid on the more elementary parts of each subject, and several typical problems are inserted. The latter relate chiefly to the arithmetical and algebraical sections, while the Euclid section is accompanied by important riders. The book should prove acceptable to those revising these subjects, whether for examination or not, and will be, both for teachers and taught, a useful companion to the text-books in use.

LETTERS TO THE EDITOR.

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Thoughts on the Bifurcation of the Sciences suggested by the Nottingham Meeting of the British Association.

THE opening paragraph of the President's address contains this sentence: "We have come to learn what progress has been made in departments of knowledge which lie outside of our own special scientific interests and occupations, to widen our views, and to correct whatever misconceptions may have arisen from the necessity which limits each of us to his own field of study."

A most worthy and attractive ideal. Something of this kind of intersectional information does go on at these meetings; but to how small an extent! It may be said, indeed, that except for the presidential address and the two evening lectures, everyone sticks to his own section, and discusses matters lying in his own groove.

This state of things is perhaps inevitable, but it is none the less to be regretted. It is extremely difficult for anyone actively engaged in the work of any one section to attempt to attend any other. I myself used to make the attempt, but concluded that the results were too precarious and uncertain to be worth the dissipation of energy involved, and have now abandoned it. Yet there can be little doubt that if the state of things postulated by the President were feasible in practice it would be a distinct gain.

But it would seem as if the modern tendency were all in the other direction. Papers in the two great scientific departments are read as far as possible on different days at the Royal Society, and are published in separate volumes. Such an arrangement is decidedly convenient: I am not repining at it. The